

## Guest Editorial

### Restoring the Foundation: Tracking Chemical Exposures and Human Health

The ubiquity of toxic substances in the environment continues to be a significant public health concern. Body burdens of chemicals such as dioxins, methyl mercury, PCBs, and a range of the “usual suspects” are the increasingly represented norm rather than the exception in the U.S. population. In the recently released National Exposure Report (National Center for Environmental Health 2003), which provides an inventory of 116 chemicals commonly encountered in the U.S. population, it appears that the levels of these key chemicals have declined over time. Although this constitutes a key success in primary pollution prevention, serious concerns remain regarding the exposure of the population to a wide spectrum of chemicals in the environment.

Many chemicals are persistent toxic substances that bioaccumulate and biomagnify and are thus expected to be detectable in the human population. Others, however, cannot be detected long after the period of exposure. For the majority of chemicals, there is a paucity of environmental population, monitoring, and health effects data. At current funding levels, it would take 1,000 years to adequately document the health effects of the chemicals commonly encountered in commerce and industry. In contrast, a limited number of substances are among the most intensively studied (i.e., the usual suspects). The literature in the broad areas of exposure, toxicity, and epidemiology for these chemicals, as summarized in the Agency for Toxic Substances and Disease Registry’s (ATSDR) toxicologic profiles, approaches 1,000 pages of peer-reviewed information. Despite this wealth of data for each of these chemicals, significant uncertainties remain regarding the overall health impact of these chemicals.

Although uncertainties exist with respect to health effects for well-characterized chemicals, even more daunting is the issue of documenting environmental exposures in the human population. Exposure data represent the weak or missing link in our efforts to characterize human health hazards due to chemical exposures. Environmental human exposures are much more complex and generally even less well defined than are associated health effects. Limited data exist that reliably characterize the range of human exposures, the number of chemicals involved in such exposures, both in combination and temporally, and the fact that these exposures occur across different and/or multiple routes and durations. This is further complicated by limitations of analytical technology. These issues led the National Research Council to conclude in 1991 that “critical information on the distribution of exposure and health effects associated with hazardous wastes [is] still lacking” (National Research Council 1991). Unfortunately, at present, the same conclusion still applies (Garrett 2000).

Pollution prevention, as evidenced by declining body burdens of hazardous chemicals, represents a success that should be celebrated and extended. Nevertheless, there is concern regarding not only the continued introduction of new chemicals (e.g., brominated fire retardants and pyrethroids) but also the increasing recognition that there has been a shift from overt manifestations of toxic action (i.e., frank neurotoxicity) to more subtle forms of toxicity often referred to as functional deficits (e.g., reproductive and neurodevelopmental deficits). After reviewing findings in wildlife, laboratory animals, and humans demonstrating adverse effects from exposure to



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persistent toxic substances (PTS) found in the Great Lakes Basin, the International Joint Commission (1997) concluded that

sufficient evidence is available ... to demonstrate that exposures to certain toxic substances ... have been sufficient to harm human health and that without interventions, future exposures will continue to harm human health.

This is relevant more generally because it has been determined that the levels of persistent toxic substances identified in the environment in the Great Lakes are not substantially different than elsewhere in the United States (De Rosa et al. 1999). This finding is even more compelling in view of the fact that exposures of vulnerable communities (including sport and subsistence fishermen, men and women of reproductive age, the developing fetus, children, the aged, the urban poor, and the immunologically compromised) may have exposures in some instances from 2 to 8 times higher than the general population. These populations represent the nexus between elevated exposure and intrinsic physiologic sensitivity to the effects of many of these substances.

In 2001, the Pew Commission (Pew Environmental Health Commission 2001) concluded that there is a

growing disparity between the national public health infrastructure and the ability to monitor the levels of these contaminants in the environment and to assess their potential impact on the general health status of the U. S. population.

Additionally, the Pew Commission concluded that the ATSDR Great Lakes Human Health Effects Research Program, established in 1992, is yielding “compelling data concerning exposure to chemical contaminants and health consequences associated with these exposures.” This program (De Rosa and Johnson 1996) was built on the traditional elements of disease prevention, including:

- Surveillance for patterns of morbidity and mortality in at-risk populations by virtue of elevated exposure and/or physiologic sensitivity
- Evaluation of the factors underlying the patterns of morbidity and mortality observed at the population level
- Interventions or control strategies that are strategically targeted to at-risk populations including health education and risk communication, so that individuals can take steps to reduce their exposure and that of their families
- Infrastructure development at the state and local levels to implement such a model of disease prevention
- Impact assessment to ensure that the interventions undertaken actually serve to improve health status of at-risk populations.

The Great Lakes Human Health Effects Research Program was predicated on broadly based coalitions and partnerships within the Great Lakes, including the U.S. Environmental Protection Agency (EPA), the International Joint Commission, the National Institute of Environmental Health Sciences, the Centers for Disease Control and Prevention, the states, and tribal nations. Elevated body burdens in vulnerable communities were reduced to background levels in a relatively short time (i.e., approximately 6 years), based on a strategically targeted health communication plan developed in a culturally

sensitive manner, without compromising fish as a nutritionally and culturally important component of the diet (Hicks et al. 2000).

This scenario, however, applies only to the persistent toxic substances associated with contaminated fish in the Great Lakes. The question of total integrated exposure reflecting exposures from hazardous waste sites, Toxics Release Inventory data, life-style factors such as tobacco smoking and alcohol use, and occupational exposures to a wide range of sometimes less persistent but nevertheless toxic materials, while controlled for, was not specifically addressed in this effort.

Consistent with the recommendations of the Pew Commission, this underscores a compelling need for and value of further development of community-based public health capacity for purposes of tracking chemical exposures and their potential human health impact. This capacity must include the ability to identify and monitor "hot spots" in the human population with respect to elevated exposure to toxic substances, as well as potential clusters of environmentally related diseases. The experiences demonstrated by researchers and policy makers from the Great Lakes states illustrate the efficacy of directing resources to community-based research to effect positive change. These experiences also demonstrate the power and effectiveness of tracking chemical exposures and translating scientific information into public health service on a local level. The ultimate objective of these efforts is to empower communities by providing to them the means to make informed decisions on personally relevant environmental public health issues.

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## REFERENCES

- De Rosa CT, Gilman AP, Rosemond ZA, eds. 1999. Special Issue: Proceedings of Health Conference '97—Great Lakes/St. Lawrence. *Environ Res* 80(suppl 2):1–248.
- De Rosa CT, Johnson BL. 1996. Strategic elements of ATSDR's Great Lakes Human Health Effects Research Program. *Toxicol Ind Health* 12(314):315–325.
- Garrett L. 2000. *Betrayal of Trust: The Collapse of Global Public Health*. New York:Hyperion.
- Hicks HE, Cibulas W, De Rosa CT. 2000. The impact of epidemiology/toxicology and public health practice in the Great Lakes. *Environ Epidemiol Toxicol* 2:8–12.
- International Joint Commission, Workgroup on Ecosystem Health. 1997. Workshop on Policy Implications of Evidence Regarding Persistent Toxic Substances and Human Health. 5–7 September 1997, Racine, Wisconsin International Joint Commission. Washington, DC:International Joint Commission, 1–15. Available: <http://www.ijc.org/boards/sab/policy.html> [accessed 13 May 2003].
- National Center for Environmental Health. 2003. Second National Report on Human Exposure to Environmental Chemicals. NCEH Publication No. 02-0716. Atlanta, GA:Centers for Disease Control and Prevention. Available: <http://www.cdc.gov/exposurereport/pdf/SecondNER.pdf> [accessed 15 May 2003].
- National Research Council. 1991. *Environmental Epidemiology: Public Health and Hazardous Wastes, Vol 1*. Washington, DC:National Research Council.
- Pew Environmental Health Commission. 2001. *Strengthening Our Public Health Defense Against Environmental Threats: Transition Report to the New Administration*. Baltimore, MD:Johns Hopkins School of Public Health. Available: [http://pewenvirohealth.jhsph.edu/html/reports/Transition\\_Technical.pdf](http://pewenvirohealth.jhsph.edu/html/reports/Transition_Technical.pdf) [accessed 13 May 2003].

## Editorial

### The Environment as a Cornerstone of Public Health

The relationship of the environment to public health is back in the spotlight. Two recently released reports from the Institute of Medicine, "The Future of the Public's Health in the 21st Century" (Committee on Assuring the Health of the Public in the 21st Century 2002) and "Who Will Keep the Public Healthy? Educating Public Health Professionals for the Next Century" (Gebbie et al. 2002), embrace conceptual frameworks and approaches that place the environment where it rightfully belongs—central to public health research, practice, and policy. In both, an ecological model of public health is advanced—one that embraces multiple determinants of health (such as healthcare and public health services, biology, social and economic factors, employment, and the natural and built environment) and emphasizes linkages and relationships among the determinants. The interactions are seen as evolving over the life course of individuals and communities, with societal-level factors critical to the public's health (Syme and Smedley 2002; Halfon and Hochstein 2002).

In this evolving framework of interactive multiple determinants operating over time, there is a heightened emphasis on the role of the environment—a step well beyond identifying environmental health sciences as a core "discipline" of public health—and recognition that understanding and improving individual and population health depends in large part on understanding environmental effects and their interactions with other determinants and on promoting policies to address them. Moreover, Gebbie et al. (2002) broadly addressed the future training of public health professionals and, against the backdrop of the ecological model and the need to truly integrate public health and medicine, made sweeping recommendations to effect changes in research, education, and practice that are of significance to environmental health professionals. Their recommendations include the following: *a*) all medical students should receive basic public health training in population-based prevention, and up to one-half of these students should be fully trained in the ecological approach to public health at an equivalent to the Master of Public Health level; *b*) public health research should move from research dominated by single disciplines or a small number of disciplines to transdisciplinary research; and *c*) the health research portfolio is disproportionately focused on biomedical research and should be realigned to increase funding for population health, primary prevention, public health systems research, and community-based participatory research. Efforts are now under way nationally to address the next steps for implementing this report.

As with the emerging recognition of threats of terrorism and weapons of mass destruction, the attention and increased visibility of the environment and public health provide both opportunities and challenges. The opportunities for environmental health arising from the confluence of the "post 9/11" world and national efforts such as the recent Institute of Medicine reports on public health are abundant. Increasingly, individuals, communities, and decision makers appreciate that public health, and environmental health as fundamental to it, is no longer just a concern for others but for themselves. For example, concern about protecting our air and water from terrorist threats has, at least for the moment, garnered additional recognition



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of the value of monitoring and protecting our air and water from other polluting sources. We recognize the potential of investments made in public health infrastructure, such as building laboratory and surveillance capacity to monitor yet unrealized terrorist threats, to provide the capacity to do the traditional day-to-day work of public health that for decades has gone neglected. Beyond terrorism, there is greater appreciation than ever that environmental factors are highly influential and complex in relation to individual and population health as, for example, the contribution of the built environment relates to physical fitness and conditions such as asthma and obesity. Transdisciplinary research, although nascent, is developing in such a way that environmental factors contributing to broad and complex health issues are considered at the outset, rather than controlled for in the analyses.

Amid all this attention and momentum, is there room for serious concern about the future role of environmental health in relation to population or public health? Absolutely. The opportunities derived from the current spotlight on terrorism include the increased visibility and recognition of the contributions of public health, not to mention increased financial support. However, there are also costs as terrorism begins to drive the public health agenda, as we focus on possible and often implausible risks and are distracted from needed efforts to confront effectively traditional and known risks. The national smallpox vaccine policy suffers from abandoning traditional public health principles, including inadequate evidence of risk of exposure given known risk and benefit of the intervention, and is just one example of the problem of dealing with the perceived threat *du jour* (Rosenstock 2002). Moreover, the new investments in public health have helped improve infrastructure, but not necessarily where the need is greatest; laboratory and monitoring capacity for biological factors and infectious disease consequences far outstrips needed investments for monitoring chemical and other factors (terrorist or otherwise) and chronic disease outcomes.

Another cautionary note is that, despite all the positive talk about the need for improved environmental health science to guide us as we seek to advance population and individual health, the science and the scientists themselves are increasingly under siege by vested interests that work to undermine the evidence that might generate unwanted policies (Rosenstock and Lee 2002). The exploitation of scientific uncertainty to avoid prudent and established public health interventions is not new but increasingly common and sophisticated, and it is often environmental health issues that center prominently, such as addressing threats of global climate change, air quality, or workplace exposures. It should come as no surprise, then—given the well-documented exploitation of ever-present scientific uncertainty to block actions in the face of the available evidence that would otherwise be seen as sufficient (e.g., policies to reduce or eliminate exposure to environmental tobacco smoke or diesel exhaust)—that we see greater resistance in the United States than in Europe to adopting the precautionary principle, which acknowledges genuine scientific uncertainty but, nonetheless, recommends preventive actions (Kurland 2002).

In conclusion, these are well-deserved exhilarating and exciting times for our field. The accomplishments reported in this issue of *EHP* are exemplary, and there are many forces that aid our work to understand and promote environmental health as a nested significant component of public health. At the same time, we should be vigilant to recognize some of the limitations posed by this new attention and to address the threats to our scientific advances and the policies that should necessarily follow.

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## REFERENCES

- Committee on Assuring the Health of the Public in the 21st Century, Institute of Medicine. 2002. The Future of the Public's Health in the 21st Century. Available: <http://books.nap.edu/books/030908704X/html/R1.html> [cited 1 May 2003].
- Gebbie K, Rosenstock L, Hernandez L, eds. 2002. Who Will Keep the Public Healthy? Educating Public Health Professionals for the Next Century. Washington, DC:National Academies Press.
- Halfon N, Hochstein M. 2002. Life course health development: an integrated framework in developing health, policy and research. *Milbank Q* 80:433–79.
- Kurland J. 2002. The heart of the precautionary principle in democracy. *Public Health Rep* 117:498–500.
- Rosenstock L. 2002. Smallpox vaccine policy is bad science. *Los Angeles Times*. 29 December: M5.
- Rosenstock L, Lee LJ. 2002. Attacks on science: the risk to evidence-based policy. *Am J Public Health* 92:14–18.
- Smedley BD, Syme SL, eds. 2002. Promoting Health: Intervention Strategies from Social and Behavioral Research. Washington, DC:National Academy Press.

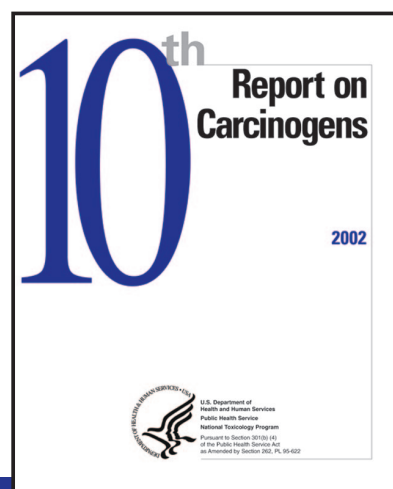
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